

# The Joint Center for Satellite Data Assimilation

*A Research to Operations Transition Organization*

<http://www.jcsda.noaa.gov>

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and

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NOAA Testbed USWRP Workshop 04/28-29, 2009

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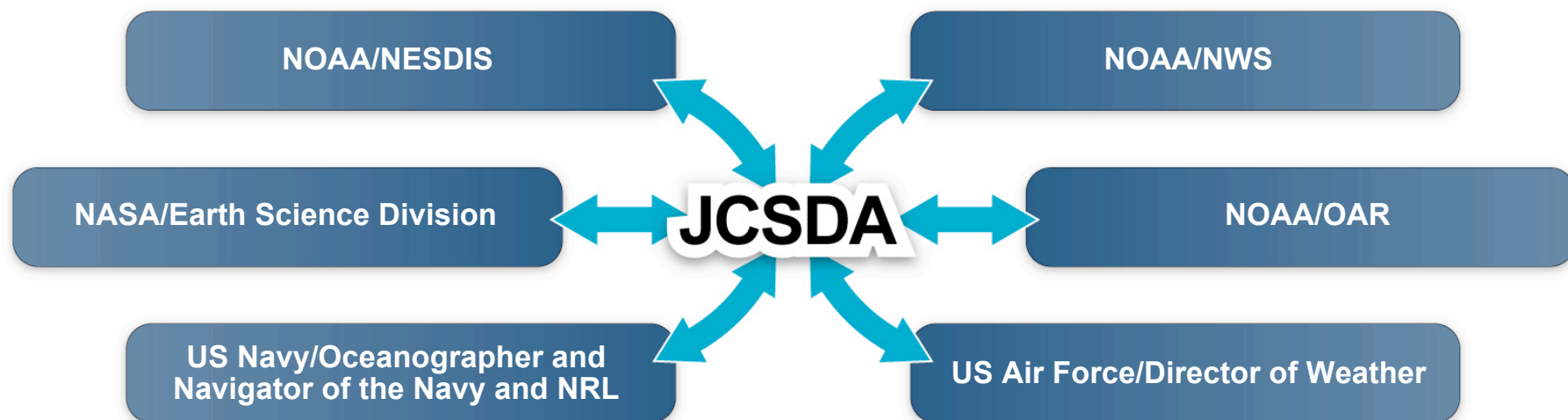
# Overview

- JCSDA, its partners vision, mission, priorities, goals and accomplishments
- New short-term NWP focus
- Supporting activities
- Summary

# JCSDA Advisory Panel 01/2009.

Prof. Rick Anthes on satellite data research:

*“The national investment in satellite data assimilation is a tiny fraction of the investments in the satellite systems themselves, yet assimilation research and implementation in operational models are essential to realize the enormous potential of the satellite data. Augmented investments in data assimilation research and the supporting computing tools are highly recommended”*

**Vision:**

*An interagency partnership working to become a world leader in applying satellite data and research to operational goals in environmental analysis and prediction*

**Mission:**

*...to accelerate and improve the quantitative use of research and operational satellite data in weather, ocean, climate and environmental analysis and prediction models.*

# JCSDA Strategic Science Priorities

- Radiative Transfer Modeling (CRTM)
- Preparation for assimilation of data from new instruments
- Clouds and precipitation
- Assimilation of land surface observations
- Assimilation of ocean surface observations
- Atmospheric composition; chemistry and aerosol

*Driving the activities of the Joint Center since 2001,  
approved by the Science Steering Committee*

# JCSDA Mode of operation

- Management Oversight Board (NOAA, NASA, DOD)
- Executive Management Team- JSCDA Partners
- MOU Terms of Reference signed by Partner Senior Execs/AAs 2008
- Directed research
  - Carried out by the partners
  - Mixture of new and leveraged funding
  - JCSDA plays coordinating role
- External research
  - NOAA-administered FFO, open to the broader research community
  - ~\$1.4 M/year available => revolving portfolio of ~15 three-year projects
    - *IPO has historically contributed \$500K/year*
    - *GOES-R Program new participant in FY10*
    - *Inclusion of DoD partners stipulated by IPO*
    - *Project list available from JCSDA web page*
  - JCSDA Annual Meeting (May 12-13, 2009)

# Role of External Research Program

- Complements internal efforts and expertise of JCSDA partners, e.g.
  - CRTM upgrades, spectroscopy, algorithms
  - Clouds and precipitation
- Engages research community in R2O transition activities of vital national importance, e.g.
  - Data assimilation methodology
  - Diagnostics of data impact and model performance

# JCSDA accomplishments

- Common assimilation infrastructure (NCEP/EMC, NASA/GMAO)
- Community radiative transfer model (all partners)
- Common NOAA/NASA land data assimilation system (EMC, GSFC, AFWA)
- Interfaces between JCSDA models and external researchers
- Snow/sea ice emissivity model – permits 300% increase in sounding data usage over high latitudes (EMC)
- MODIS polar winds (EMC, GMAO, FNMOC)
- AIRS radiances assimilated (EMC, GMAO)
- COSMIC data assimilation (EMC)
- Improved physically based SST analysis (EMC)
- Advanced satellite data systems such as DMSP (SSMIS), CHAMP GPS, WindSat tested for implementation (EMC)
- Data denial experiments completed for major data base components in support of system optimization (GMAO)



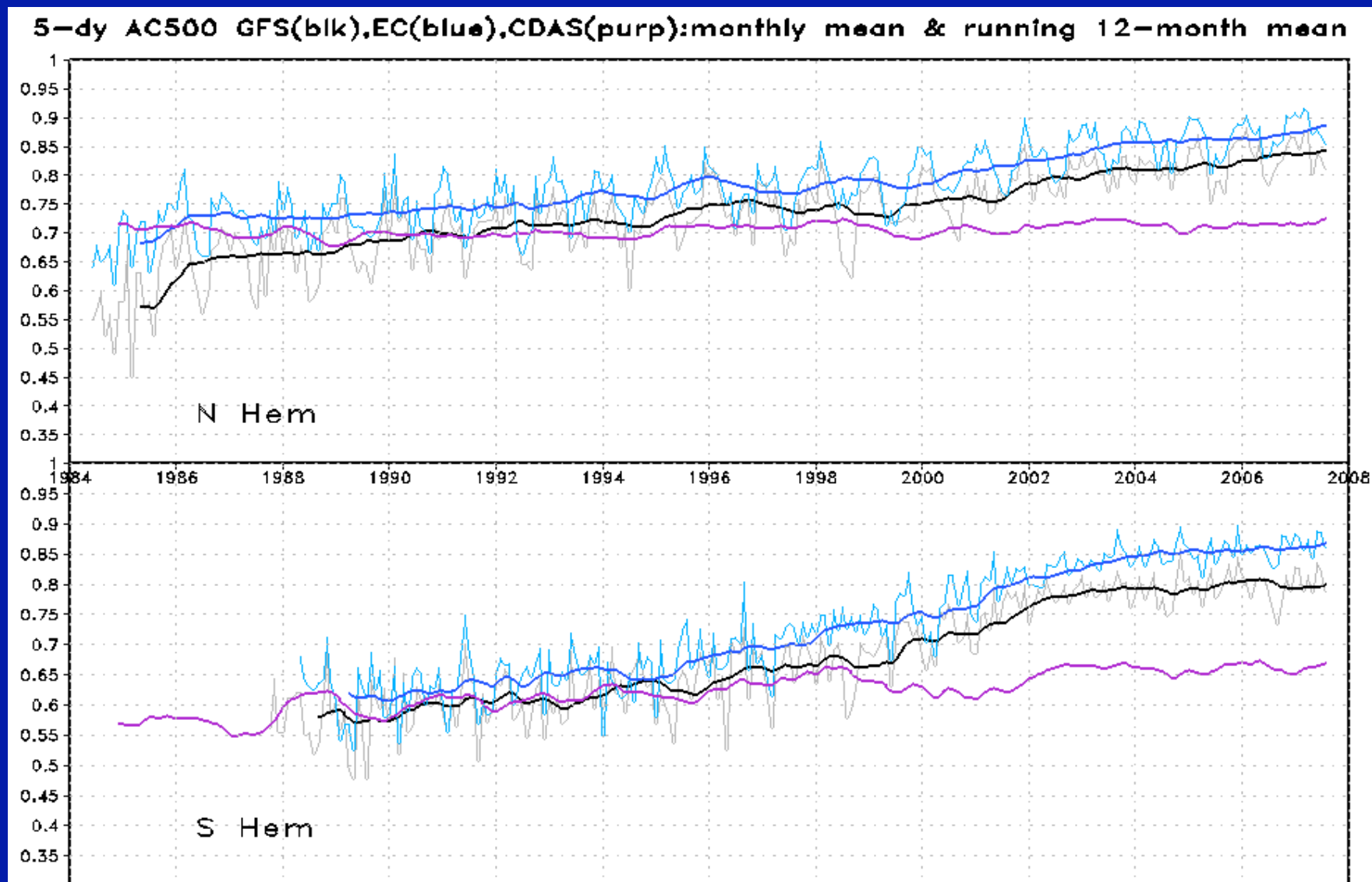
## New JCSDA short-term goal: *(adopted 03/2008)*

- *“Contribute to making the forecast skill of the operational NWP systems of the JCSDA partners internationally competitive by assimilating the largest possible number of satellite observations in the most effective way”*

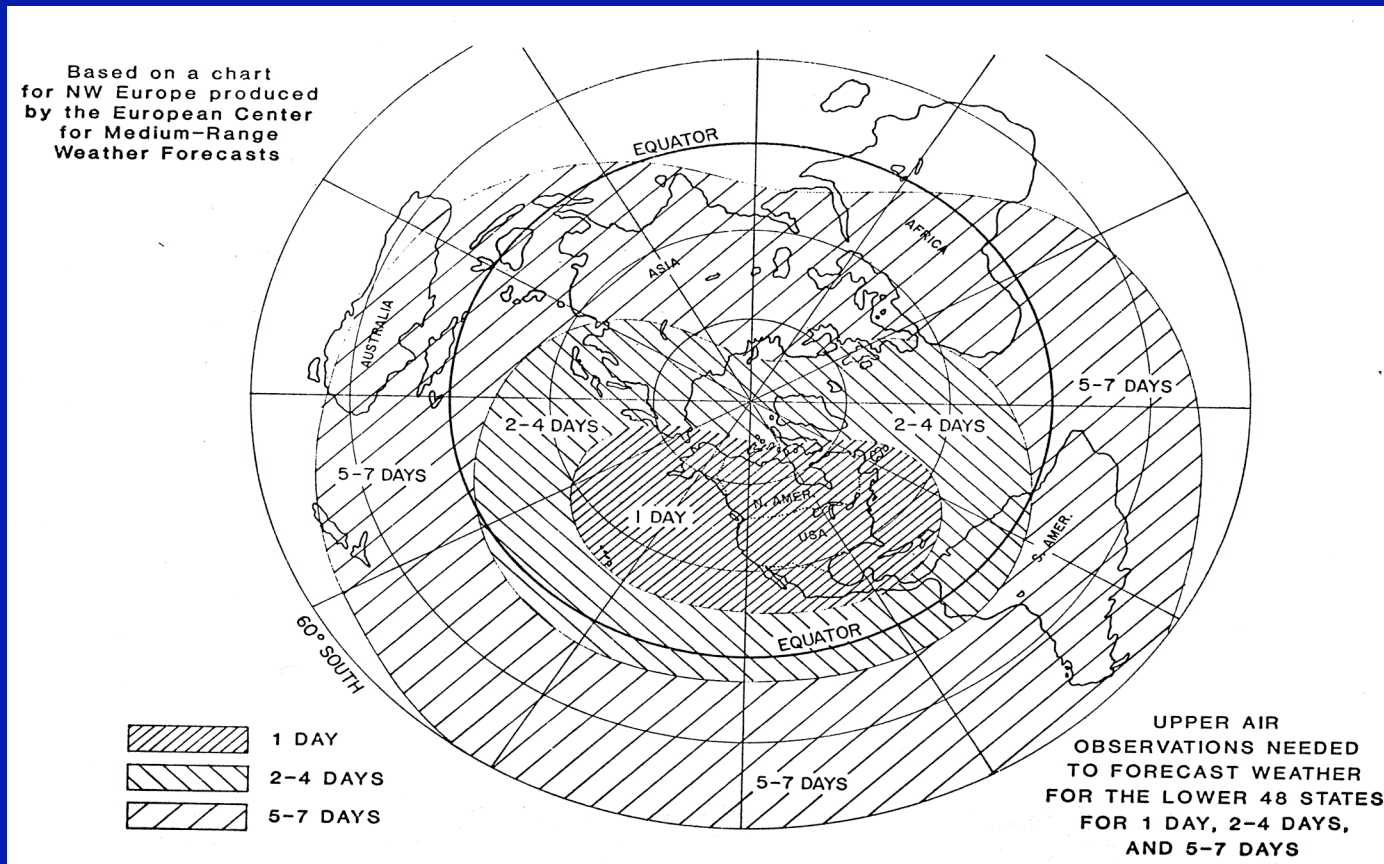
# Why is JCSDA interested in this?

- NWP is an extremely important component of what we do, both for civilian and military applications
- US falling behind internationally in terms of NWP skill
- Satellite data play a major role in NWP skill

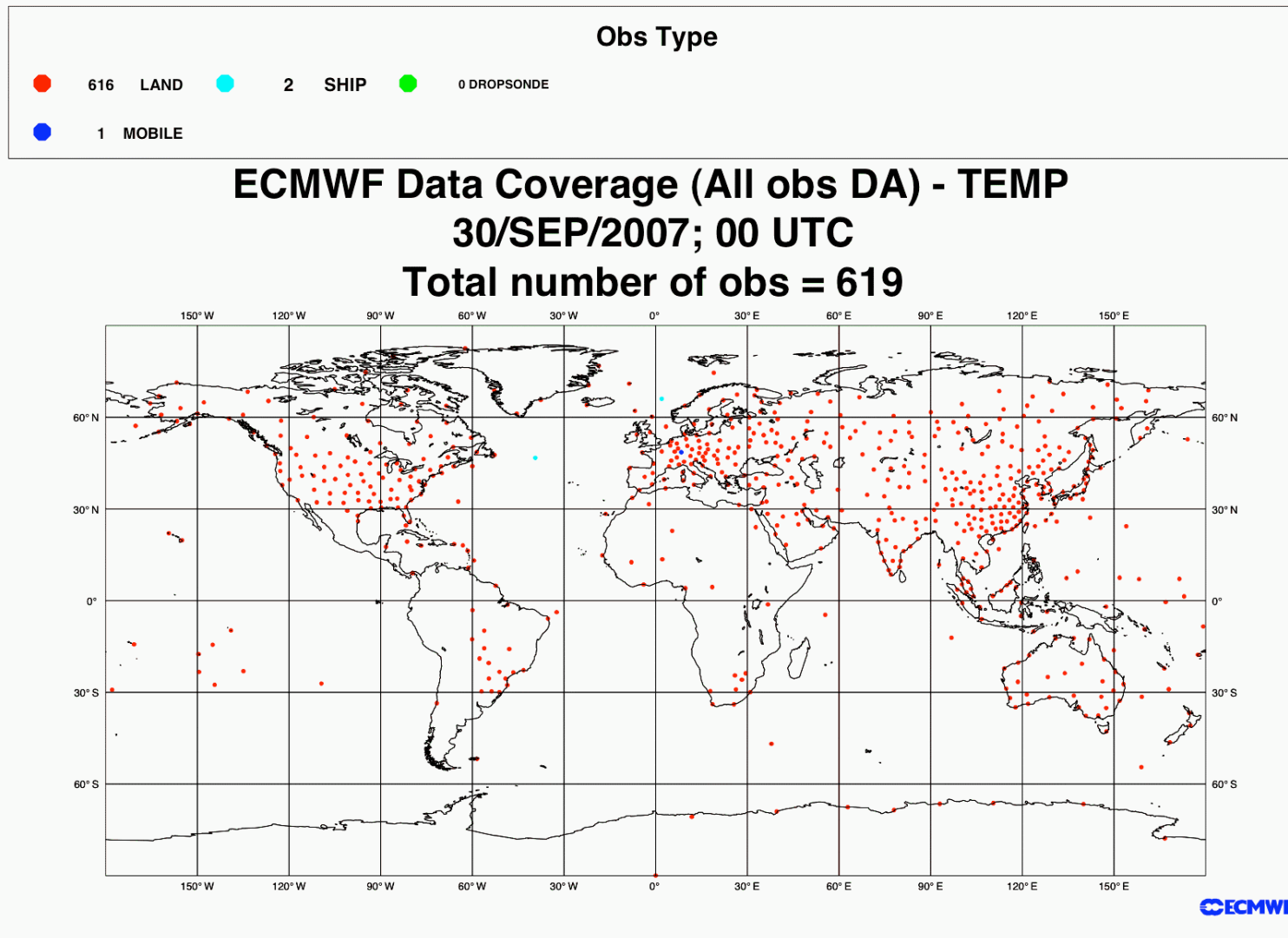
# NOAA/NCEP vs. ECMWF skill over 20+ years



# NWP requirements for upper-air data coverage

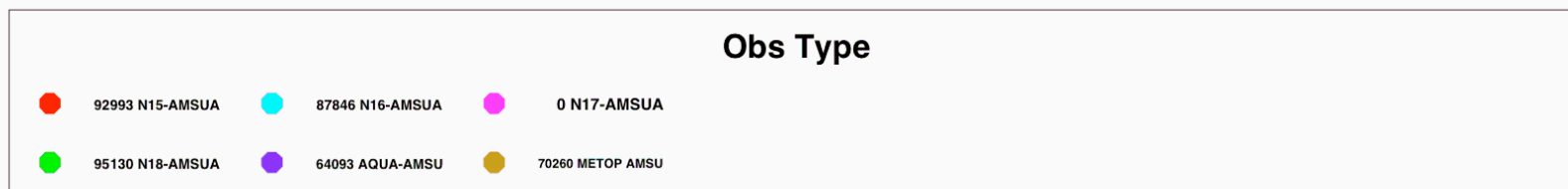


# Conventional obs (u, v, T, q, vertically resolved)





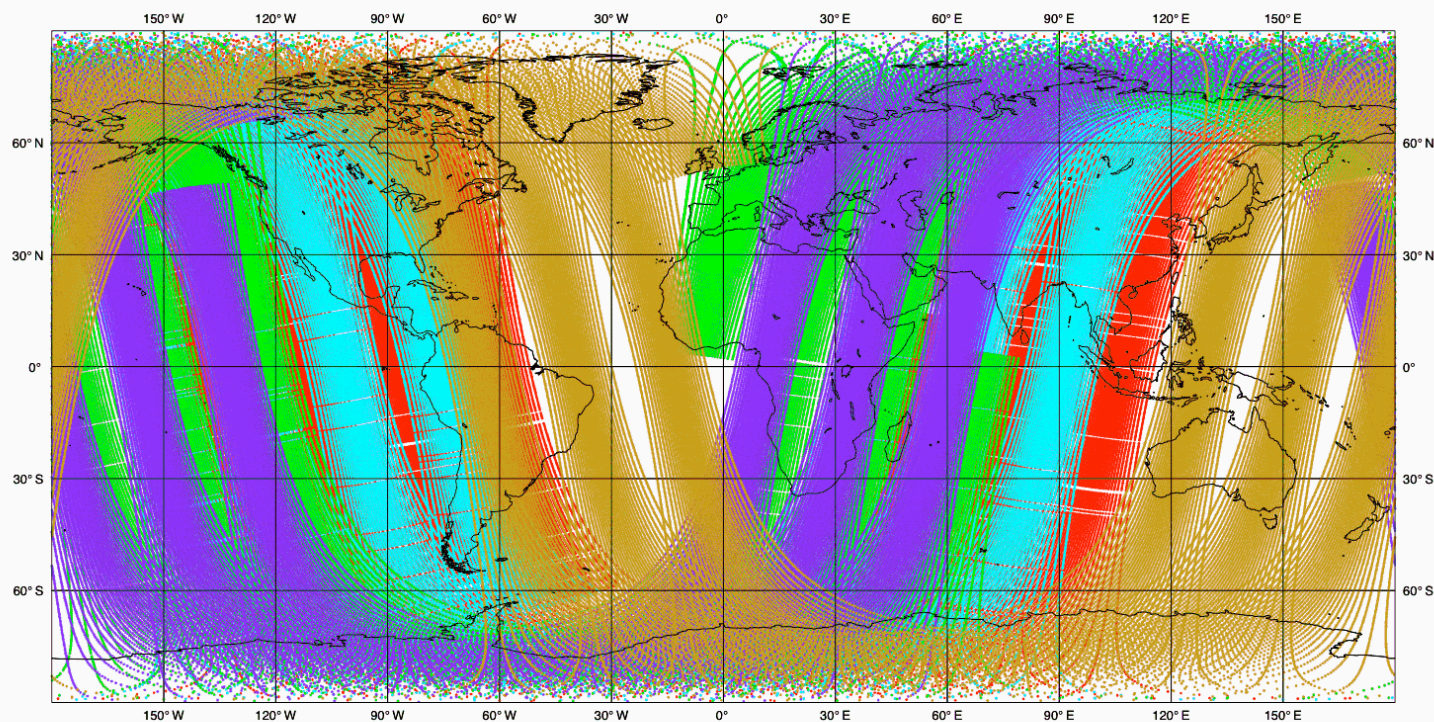
# Example satellite data coverage (AMSU-A)



**ECMWF Data Coverage (All obs DA) - ATOVS**

**30/SEP/2007; 00 UTC**

**Total number of obs = 410322**

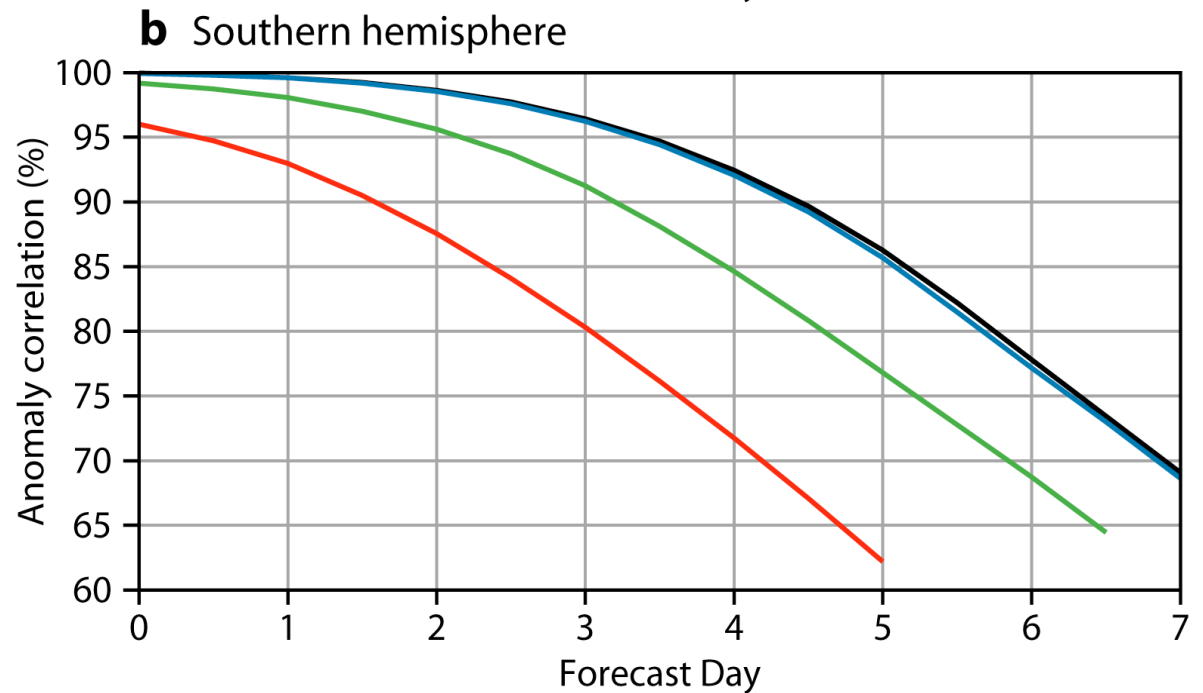
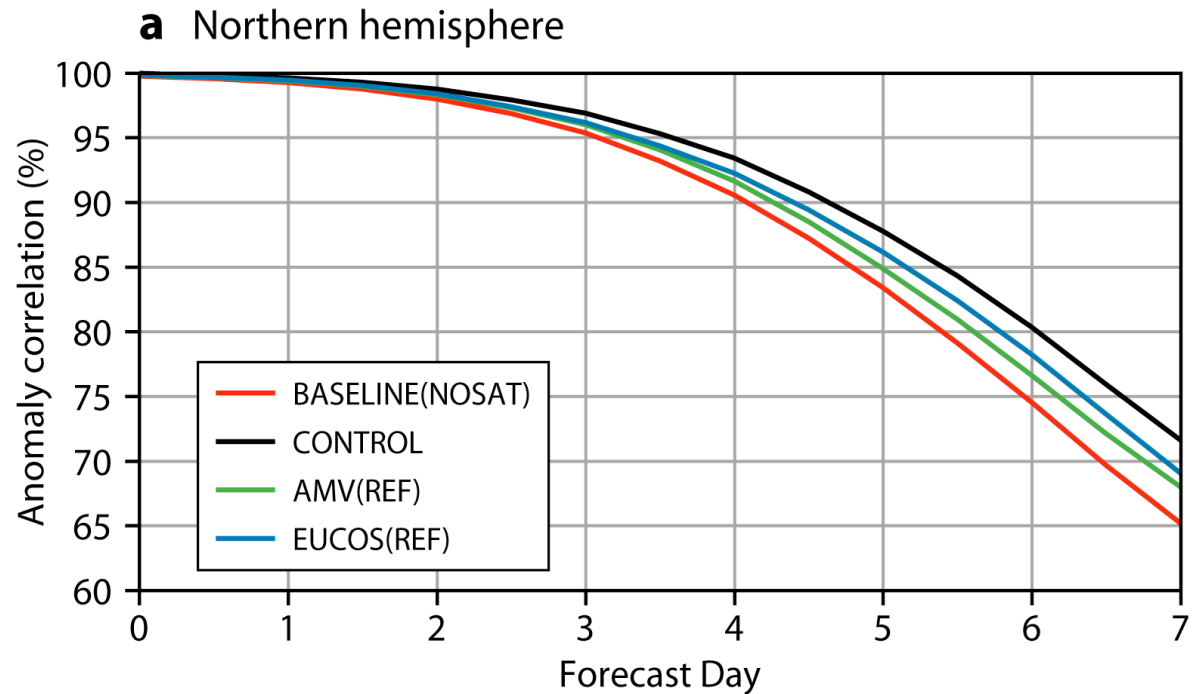


ECMWF

Comparison of  
*EUCOS(REF)* and  
*AMV(REF)* with  
*BASELINE (NOSAT)*  
and *CONTROL*

(a) northern  
hemisphere

(b) southern  
hemisphere



# Why is the US falling behind?

- Use of satellite data
  - JCSDA can help, *currently insufficiently resourced to keep up with data from new sensors (e.g. IASI, ASCAT) and continually improve the use of data currently assimilated (e.g. AIRS, MODIS)*
- Data assimilation system development; no unified US move toward next-generation (4D-VAR) data assimilation capability
  - JCSDA has no direct control over this, *but can facilitate and coordinate collaboration on satellite data among various research and operational efforts within the US*



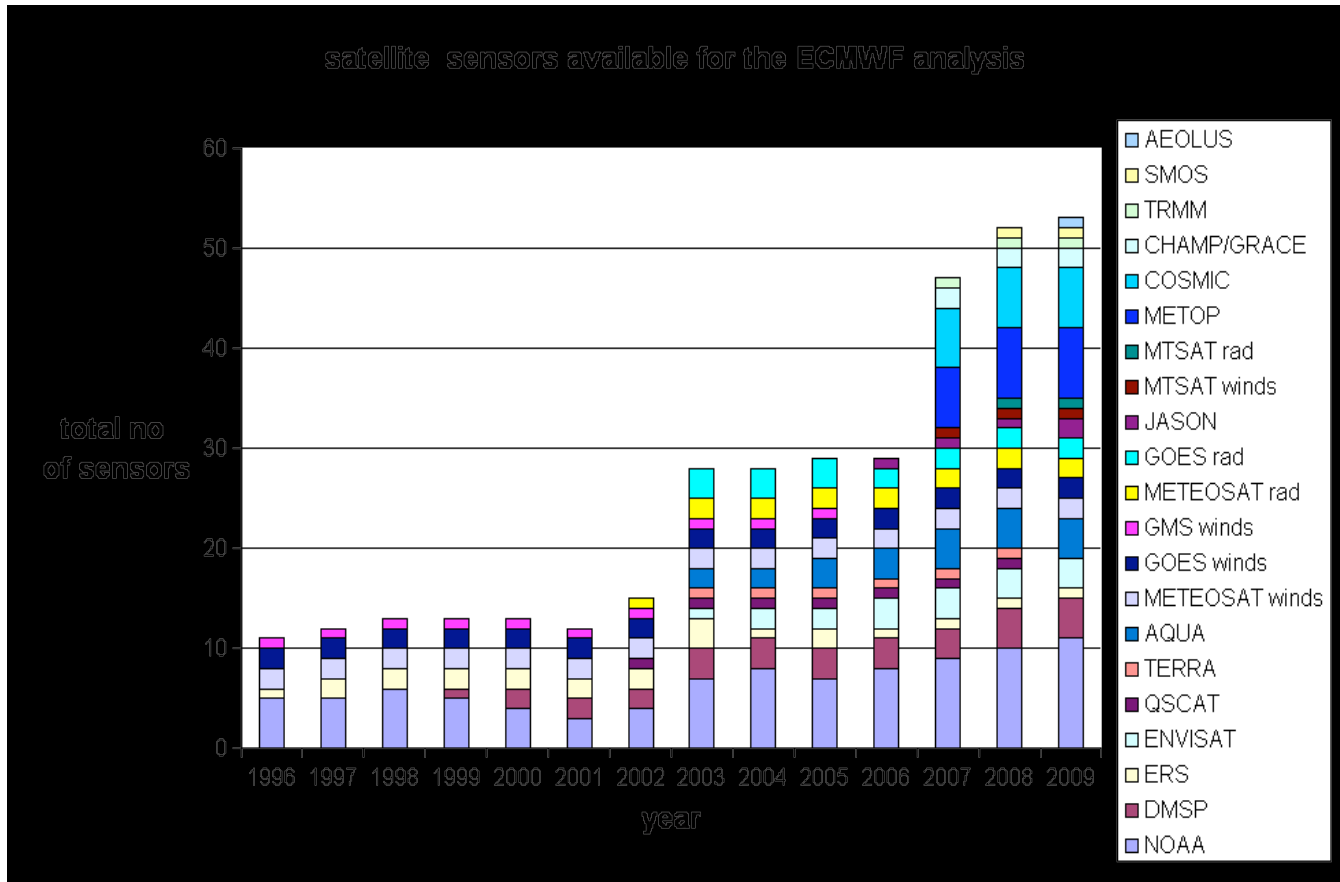


# Satellite Data used in NWP

- **HIRS sounder radiances**
- **AMSU-A sounder radiances**
- **AMSU-B sounder radiances**
- **GOES sounder radiances**
- **GOES, Meteosat, GMS winds**
- **GOES precipitation rate**
- **SSM/I precipitation rates**
- **TRMM precipitation rates**
- **SSM/I ocean surface wind speeds**
- **ERS-2 ocean surface wind vectors**
- **Quikscat ocean surface wind vectors**
- **AVHRR SST**
- **AVHRR vegetation fraction**
- **AVHRR surface type**
- **Multi-satellite snow cover**
- **Multi-satellite sea ice**
- **SBUV/2 ozone profile and total ozone**
- **Altimeter sea level observations (ocean data assimilation)**
- **AIRS**
- **MODIS Winds**
- **COSMIC**

~33 instruments

**Number of satellite sensors that are or will be soon assimilated in the ECMWF operational data assimilation.**



# Operational implementation plans (NCEP/EMC):

- |                          |                  |
|--------------------------|------------------|
| • Windsat                | 3rd Q FY08       |
| • IASI                   | 1st Q FY09       |
| • ASCAT                  | “                |
| • COSMIC (bending angle) | “                |
| • OMI ozone              | “                |
| • SSMI/S                 | “                |
| • GRAS                   | (date still TBD) |
| • Sat winds EE screening | “                |
| • GOME-2                 | “                |

## Meanwhile ...

- IASI, ASCAT operational at ECMWF on 06/12/2007
- IASI, ASCAT operational at the Met Office 11/28/2007
- JCSDA lagging by one to two years; inadequate planning and resource allocation
- *JCSDA will have to invest heavily in NPP and ADM now in order to prevent this from happening again*

# JCSDA NWP metrics

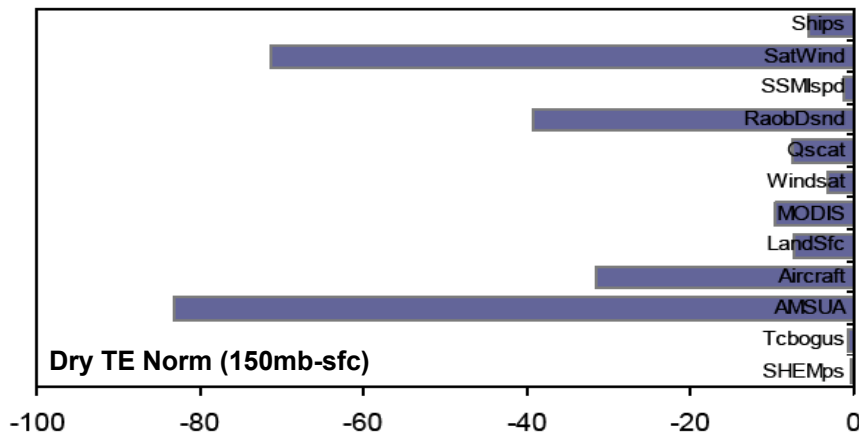
- Two metrics will be tracked
  - One related to numbers of sensors and numbers of observations
  - One related to performance

# JCSDA Activities in support of NWP goal

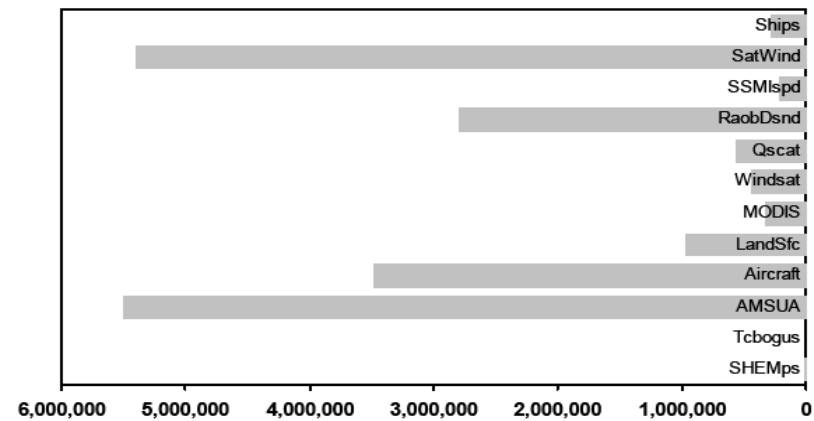
- Data impact assessment
- Radiative Transfer Modeling
- Monitoring and improvement of use of current data
- Preparation for new sensors

## Total impact by instrument type – Jan2007

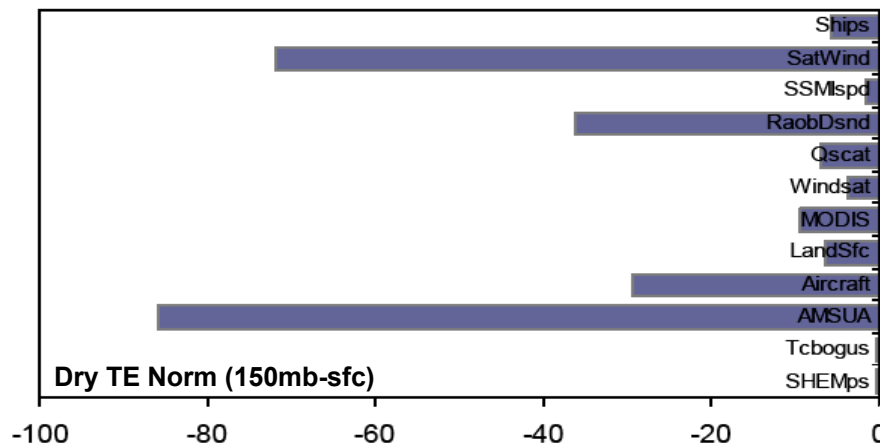
NAVDAS 24h Ob Impact Jan2007 00Z+06Z ( $\text{J kg}^{-1}$ )



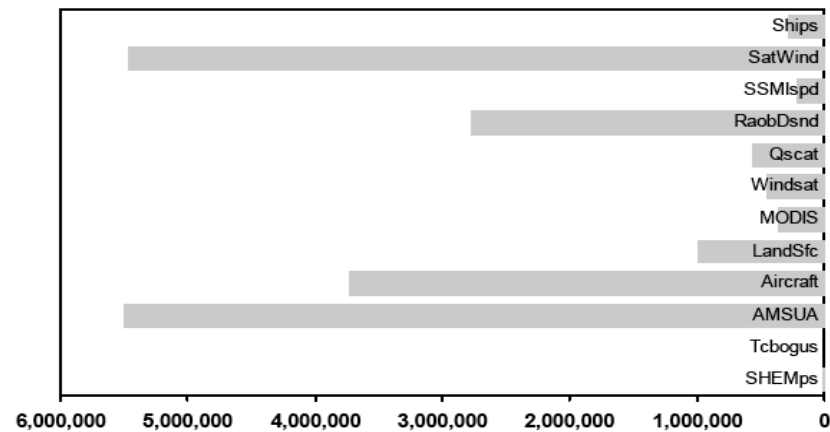
NAVDAS Ob Count Jan2007 00Z+06Z



NAVDAS 24h Ob Impact Jan2007 12Z+18Z ( $\text{J kg}^{-1}$ )

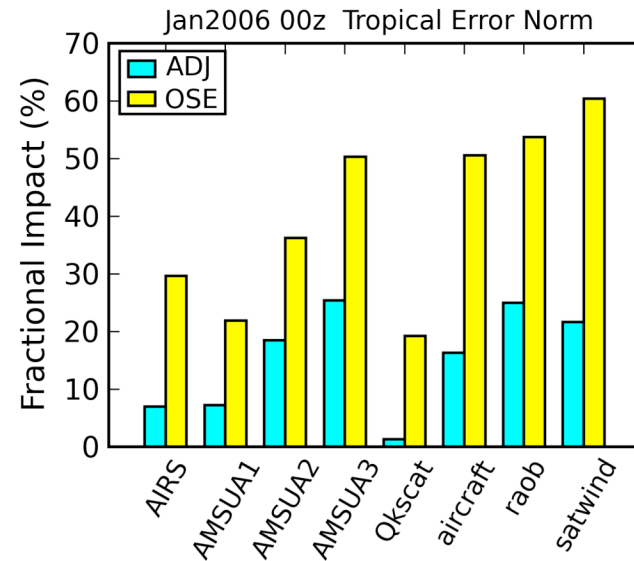
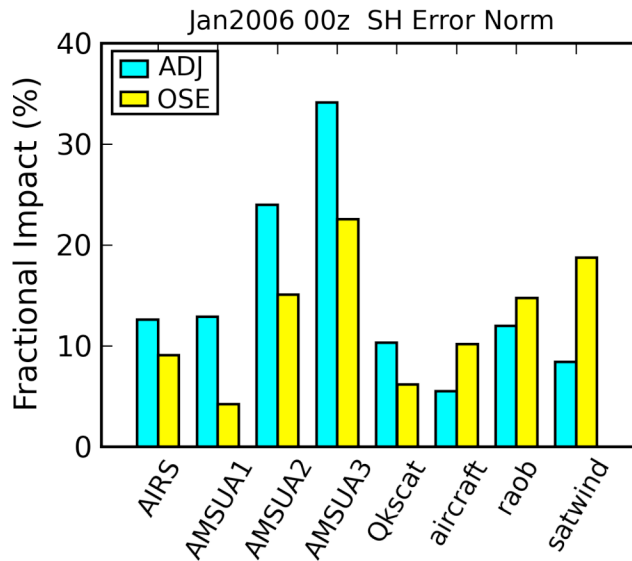
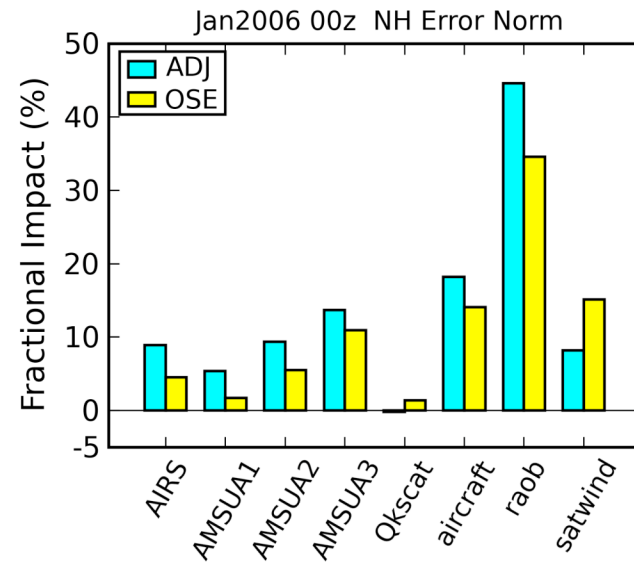
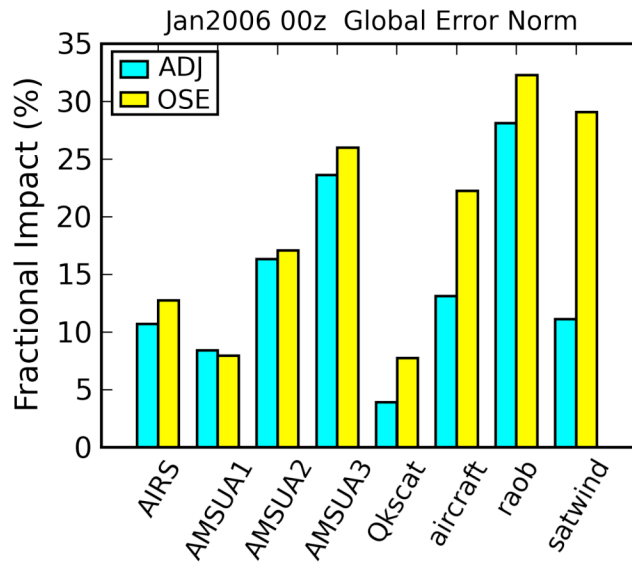


NAVDAS Ob Count Jan2007 12Z+18Z



# % Contributions to 24hr Forecast Error Reduction

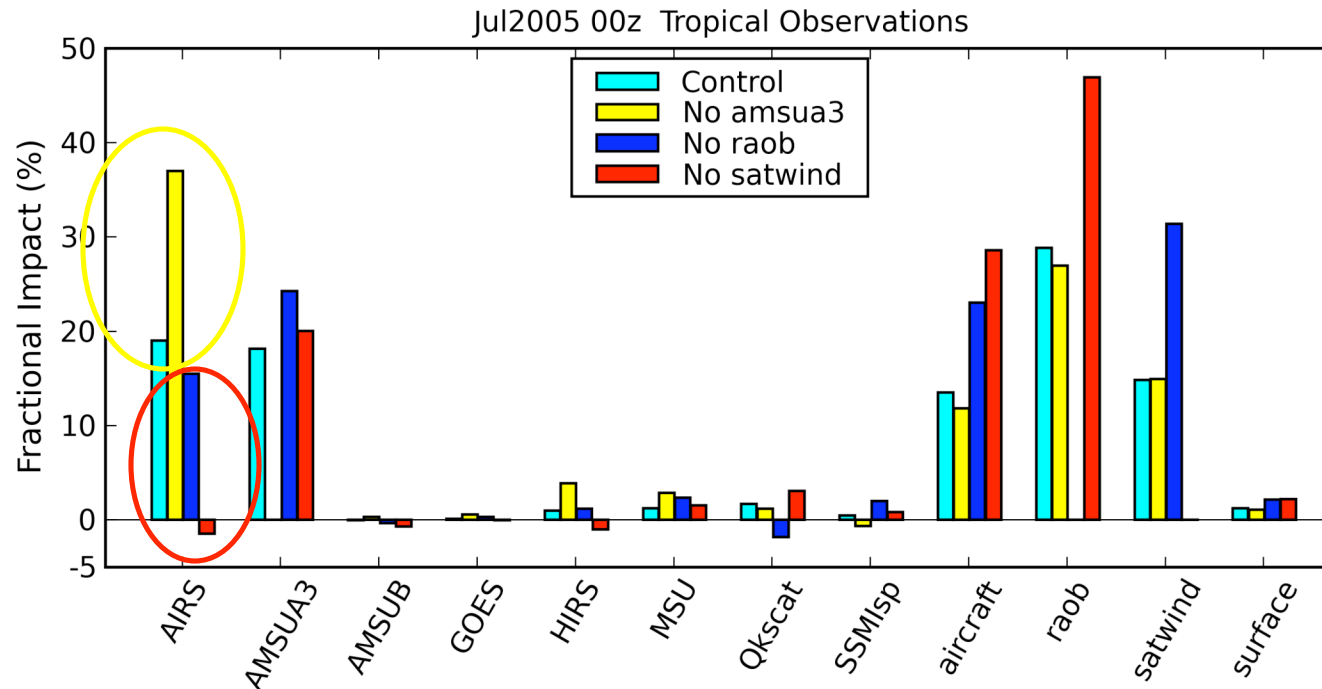
January 2006





# Combined Use of ADJ and OSEs

...ADJ applied to *various* OSE members to examine how the mix of observations influences their impacts



- Removal of AMSUA results in large increase in AIRS impact in tropics
- **Removal of wind observations** results in significant **decrease** in AIRS impact in tropics (in fact, AIRS **degrades** forecast without satwinds!)

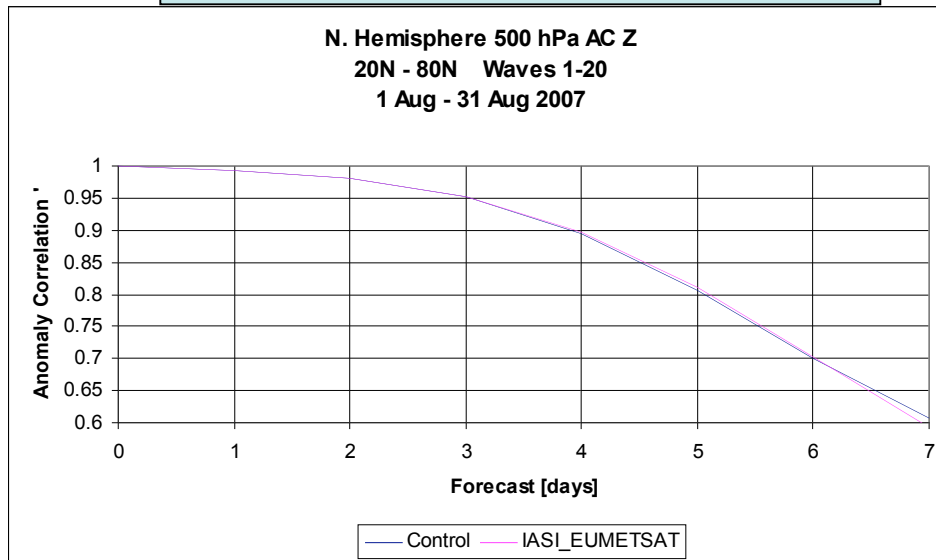
# IASI Impact Tests

- First attempt to use data at JCSDA/NCEP(EMC)
- Channel selection: EUMETSAT longwave only
- 30 day spinup for bias correction
- Experiment and control use same initial bias corrections
- Scores averaged over last 30 days
  - 1-31 August 2007
  - 16 December 2007 -15 January 2008

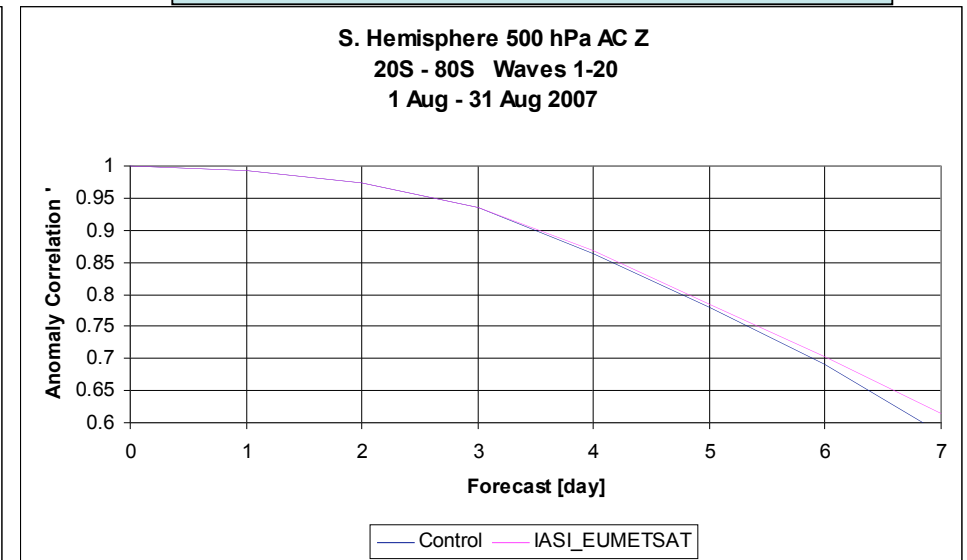
# IASI Impact on Standard Verification Scores

1-31 August 2007

NH 500 hPa Height Anom. Cor.



SH 500 hPa Height Anom. Cor.

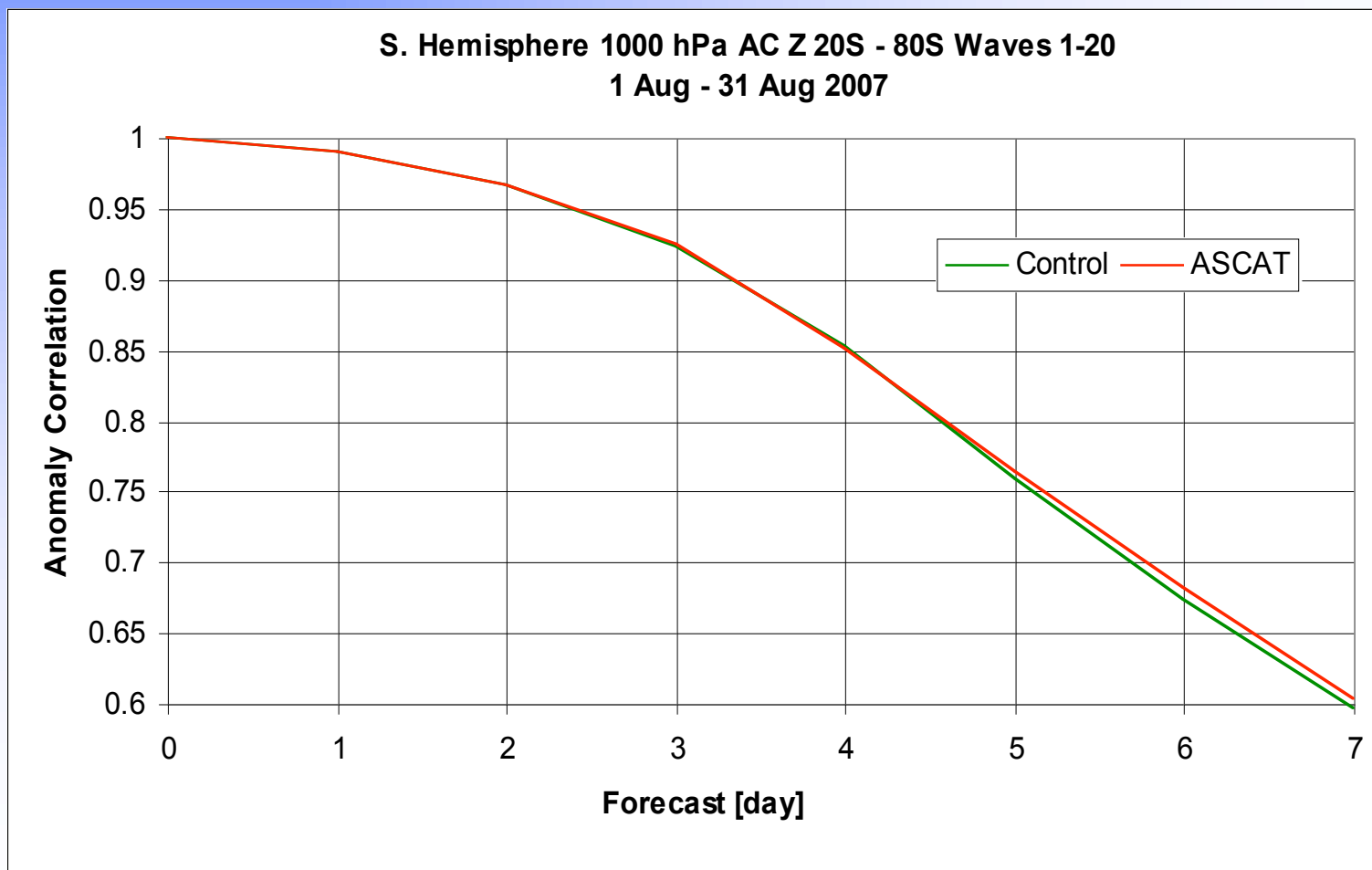


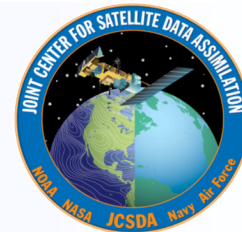
IASI  
Control

J. Jung

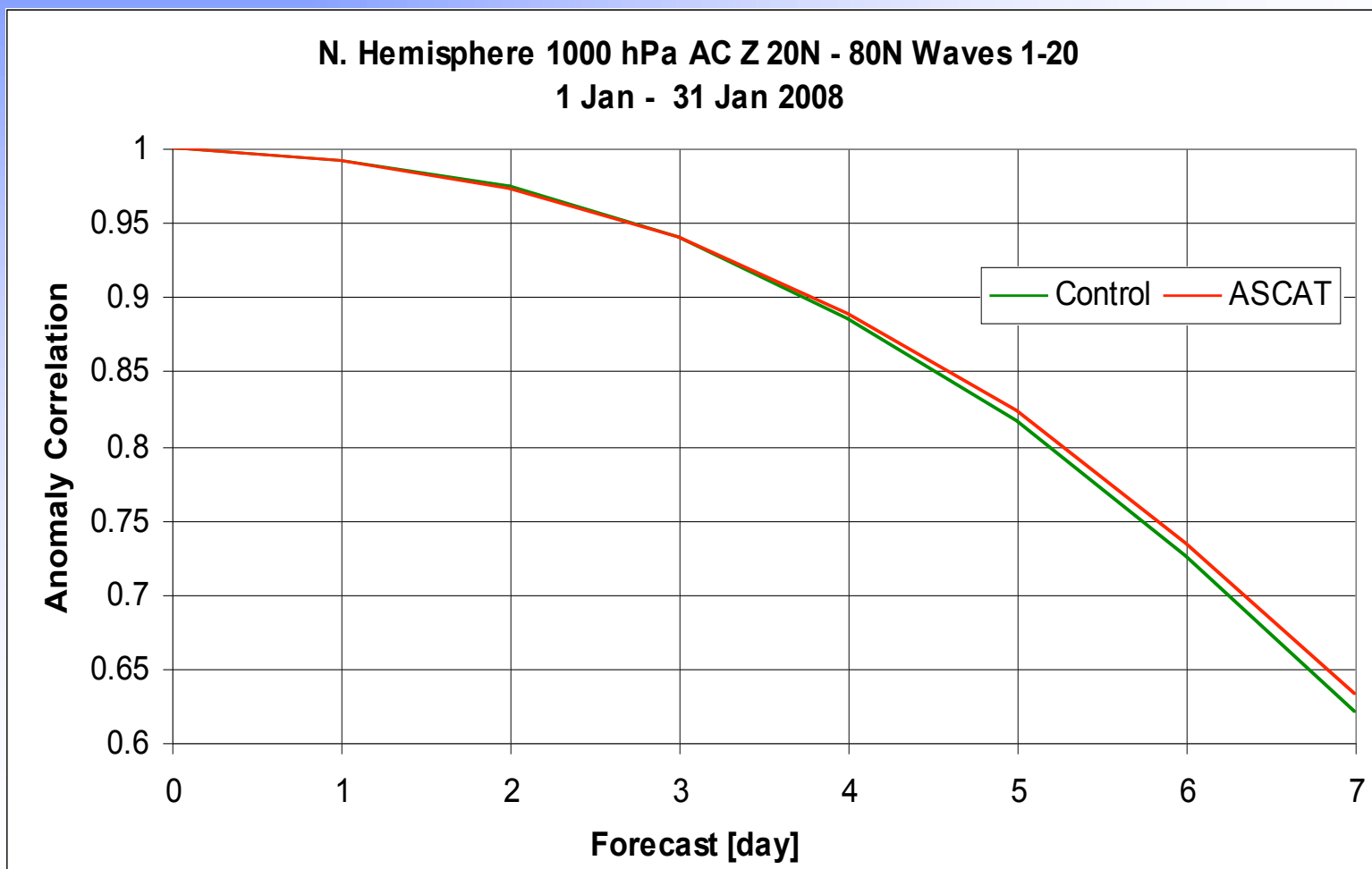


## ASCAT Impact Experiments with GFS



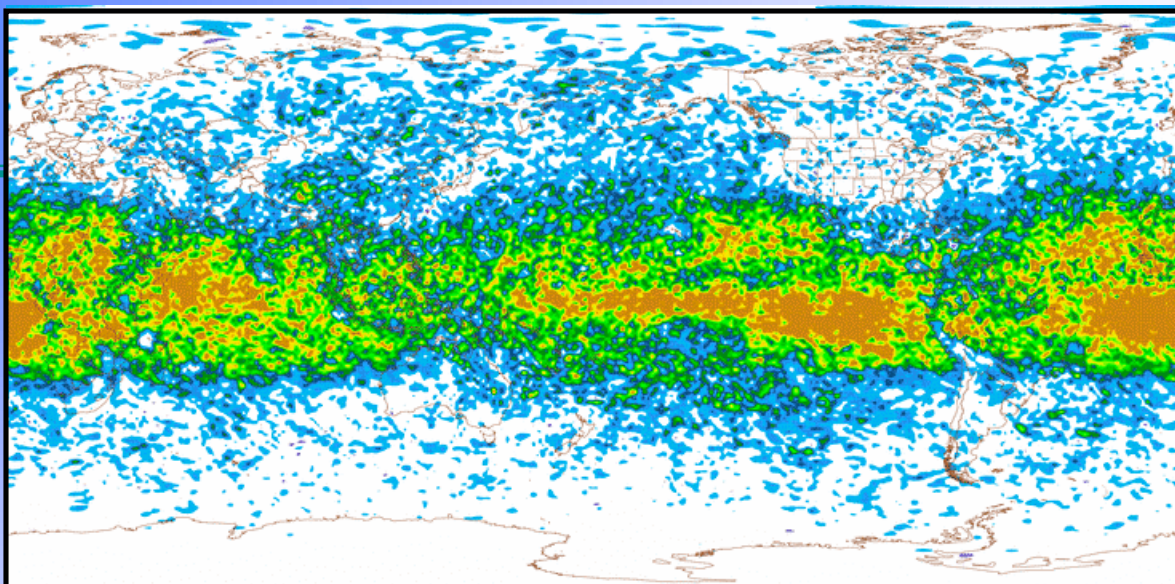


## ASCAT Impact Experiments with GFS (II)

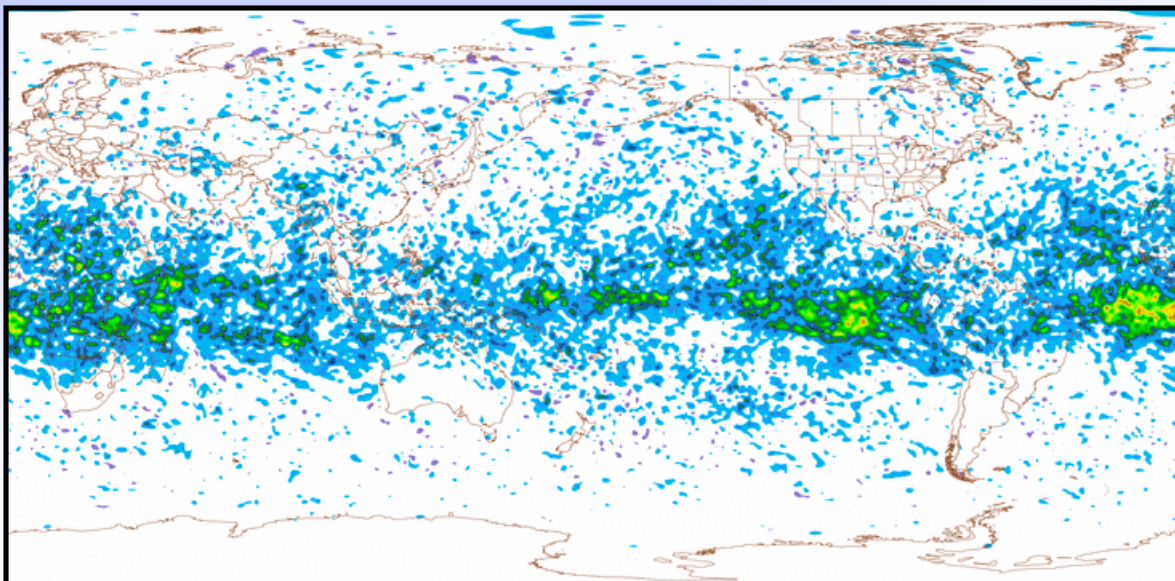




(a) 500hPa WIND SPEED FCST IMPACT [%] 6HR ASCAT 1-31 Aug 2007



(b) 500hPa WIND SPEED FCST IMPACT [%] 24HR ASCAT 1-31 Aug 2007



# NPP (NPOESS) readiness

- Scientific readiness; need to understand calibration, observation operators (spatial and spectral sampling characteristics), error modeling
  - first step is to maximize the impact of heritage sensors
    - CrIS; AIRS, IASI
    - VIIRS; AVHRR, MODIS, GOES, SEVIRI, JAMI
    - ATMS; AMSU-A, AMSU-B, HSB, MHS
    - OMPS-N; SBUV, GOME-2
  - *Lack of investment in data from Metop-A/MSG sensors hurting preparations for NPP and NPOESS data*
- Technical readiness for data flow: data transfer protocols, BUFR formats, data ingest logistics, etc.

# NPP staffing (goal)

- One lead scientist per sensor (VIIRS, CrIS, ATMS, OMPS-N) to prepare for implementation within one of the JCSDA partners
- One technology transfer specialist per sensor responsible for technology transition to and interacting with other JCSDA partners
- Compared to similar efforts elsewhere, this is a highly efficient way of making use of JCSDA collaboration!



# JCSDA Advisory Panel 01/2009

Dr. James F.W. Purdom (Panel Chair) on JCSDA FFO:

*“We are concerned with the decreased funding of the Federally Funded Opportunity (FFO) program, as it is the gateway to the academic community. We recommend continuing to fund the FFO as a grant and offering the most promising FFO research a contractual arrangement to move toward operational implementation”*



# JCSDA

## Joint Center for Satellite Data Assimilation

A multi-agency research center created to improve the use of satellite data for analyzing and predicting the weather, the ocean, the climate and the environment



[Skip Top Navigation](#)

### ▶ [JCSDA Home >>](#)

- [About JCSDA](#)
- [Organizational Structure](#)
- [Strategic Plan](#)
- [Management Oversight Board](#)
- [Executive and Staff](#)
- [Scientists](#)
- [Sitemap](#)
- [Acronyms](#)

### ▶ [Partners](#)

### ▶ [Quarterly Newsletter](#)

### ▶ [Projects](#)

### ▶ [Seminars](#)

### ▶ [Meetings](#)

### ▶ [Publications](#)

### ▶ [Research Opportunities](#)

### No New JCSDA Federal Funding Opportunity for Fiscal Year 2009

Due to the tight budget situation, the Joint Center Management Oversight Board and Executive have made the decision not to solicit new external research proposals this year. [Read more.](#)

## Welcome to the Joint Center for Satellite Data Assimilation (JCSDA)

### Benefits of JCSDA

Effective environmental prediction requires several elements. One of these is accurate, well-distributed observations of the Earth's environment, for which satellite sensors are the largest source.

Numerical models that embody the physical and chemical laws governing the behavior of the Earth's land surface, oceans, and atmosphere are another element, as are powerful computing systems to run these models rapidly to provide timely forecasts.

The science of data assimilation is the mortar that binds these elements into successful prediction systems for weather, oceans, climatology, and ecosystems. The Joint Center for Satellite Data Assimilation (JCSDA) is dedicated to developing and improving the ability to exploit satellite data more effectively in the United States. The JCSDA is a distributed collaborative effort that allows the work required to use the billions of satellite observations available daily to be shared several operational agencies in the United States.

This activity is best accomplished with a coordinated multi-agency basis as the common development work necessary to assimilate these many thousands of millions of satellite observations each day would otherwise be duplicated across the agencies.

### JCSDA Vision:



### JCSDA Announces New Visiting Scientist Program in Satellite Data Assimilation

The program is sponsored by University Corporation for Atmospheric Research (UCAR), in cooperation with the Air Force Weather Agency, and the positions are tenable at the JCSDA in Camp Springs, MD. Applications are being sought for research scientists interested in advancing satellite data assimilation techniques in numerical weather prediction (NWP) and land surface modeling, and transitioning these improvements into the operational community-supported weather models run at the AFWA.

For further details and application information see:

[http://www.vsp.ucar.edu/opportunities/AFWA\\_JCSDA.html](http://www.vsp.ucar.edu/opportunities/AFWA_JCSDA.html).

### JCSDA Advisory Panel Meeting January 27-28, 2009

The JCSDA Advisory Panel met on January 27-28, 2009, at the NOAA Silver Spring Metro Complex, Building 2, Silver Spring, Maryland. Presentations from this meeting are [posted here](#).

### JCSDA Director Co-Chairs NWP Session at 2009 EUMETSAT Meteorological Satellite Conference

The 2009 EUMETSAT Meteorological Satellite Conference will be held in Bath UK from September 21 to 25. One of

# *Additional Components and Activities*

- Regional NWP (AFWA, ESRL, NCEP/EMC)
- CRTM Working group
- Interactions with COPC, NUOPC
- Joint OSSE
- Global 4D-VAR development (EMC, GMAO)
- Regional 4D-VAR plans (EMC, GMAO, AFWA/NCAR)
- Data impact studies with COSMIC, MODIS Winds, Windsat, SSMI/S, ...
- Rapid Refresh
- GOES-R AWG and Risk Reduction
- JCSDA Summer Colloquium, Stevenson, WA
- Budget
- ...

# Summary

- JCSDA is tasked with accelerating the transfer of satellite data and satellite data research into operational analysis and prediction systems
  - *Recent refocus on NWP skill*
- Closely linked with operational readiness for NPP/NPOESS
- Continued need for interaction with outside research community and other US entities with an interest in data assimilation and/or R2O, including DTC and SPoRT